A REVIEW OF NORTH AMERICAN *RHODOPHAEA* (PHYCITINAE: PYRALIDAE), WITH DESCRIPTION OF SIX NEW SPECIES

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As conceived by Heinrich (1956) the Holarctic phycitine genus *Rhodophaea* was represented in North America by two species—*R. caliginella* (Hulst), an oak-feeder, and *R. supposita* (Heinrich), which feeds on Rosaceae. Six species are described here; all feed on members of the family Fagaceae in California or adjoining portions of Arizona and Nevada. Heinrich's *R. supposita*, described from British Columbia, is synonymized with the Palaearctic *R. suavella* (Zincken), and probably represents an introduction by man. The type of genus *Rhodophaea*, *R. advenella* (Zincken), and three other species, (including *R. suavella*), occur in the Palaearctic.

During an ecological study of microlepidoptera feeding on Fagaceae in California (Opler, 1974), six new *Rhodophaea* were reared, and larval shelters probably representing other new species were found.

Forewing color patterns of North American *Rhodophaea* are similar and the identification of any specimen should be based on the examination of dissected genitalia. Variation in color pattern among individuals reared from one host population may approach the variation shown between species. Both male and female genitalia display relatively little variation within reared series, and offer good specific characters.

Members of the genus *Rhodophaea* are extremely similar to those of *Acrobasis* Zeller. Heinrich distinguished *Rhodophaea* chiefly on the shape of the basal antennal segment. Thus, as now conceived, *Rhodophaea* possibly is constituted of several species groups independently derived from *Acrobasis* or its ancestors several times in the Tertiary.

Taxonomic Characters

Forewing color pattern. The scale color markings used are (Figure 1): (1) small elongate patch at base of inner margin, usually dark (*inner basal patch*); (2) basal portion, exclusive of (1), usually pale (*basal area*); (3) post-basal bar extending from costal margin toward inner margin, usually dark contrasting with pale *basal area*, and often edged outwardly with brown, tan or reddish (*basal bar*); (4) a sub-

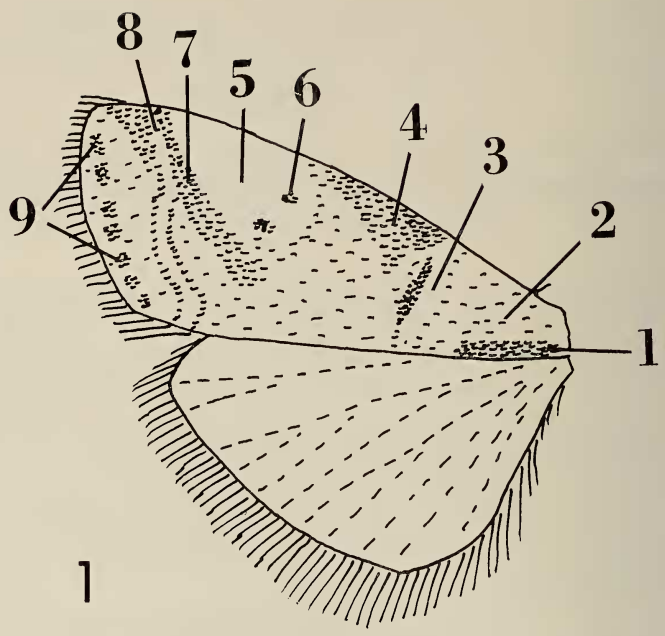
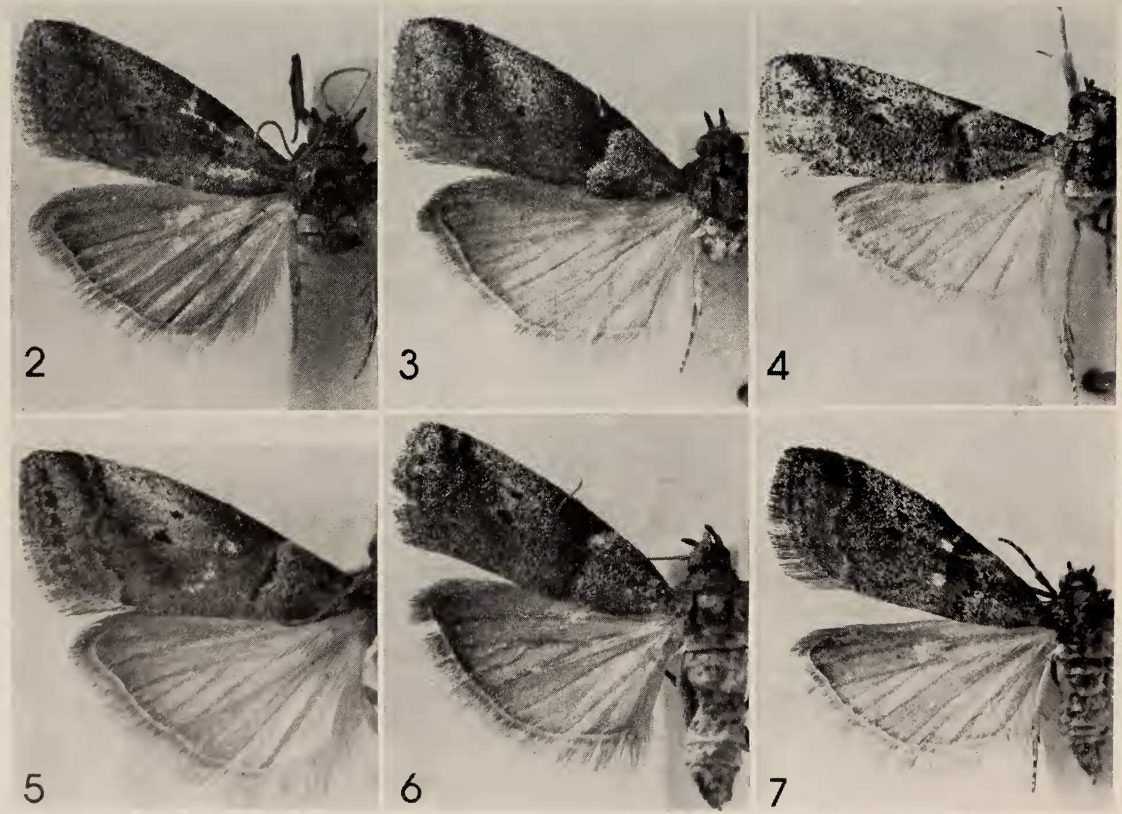


Fig. 1. Diagrammatic illustration of *Rhodophaea* forewing color pattern features employed in descriptions, 1. inner basal patch, 2. basal area, 3. basal bar, 4. s-m patch, 5. p-m patch, 6. spots, 7. band, 8. p-m line, 9. patches.

medial triangular patch of black scales along costal margin, distal to bar (*s-m patch*); (5) postmedial pale area along costal margin (*p-m patch*); (6) two black spots in lower portion of p-m patch (*spots*); (7) a diffuse, diagonal, dark band extending from costal margin inwardly toward, but not reaching, inner margin (*band*); (8) a sinuous pale postmedian line (*p-m line*); (9) and a row of small black elongate patches just inward to outer margin (*marginal patches*).

Genitalia. In male *Rhodophaea* the inner surface of the valva possesses protuberances which are constant in configuration for each species, and are the prime species character used for that sex. In female *Rhodophaea* the number and configuration of the signa bursae are most diagnostic.

Hosts. New World *Rhodophaea* are known to feed on only one or two closely related hosts, e.g., *Rhodophaea caliginella* on *Quercus agrifolia* and *Q. wislizenii.* More than one *Rhodophaea* may be found on the phenotypically and genetically complex *Quercus dumosa-turbinella* populations of mainland California.



Figs. 2–7. Adult *Rhodophaea*, left fore and hindwings —3×. 2. *R. caliginella*; 3. *R. cruza*; 4. *R. kofa*, holotype; 5. *R. durata*; 6. *R. fria*; 7. *R. neva*.

Type deposition. Holotypes and allotypes of species described herein are deposited in the California Academy of Science, San Francisco, on indefinite loan from the Essig Museum of Entomology, University of California, Berkeley.

Taxonomic Treatment

Type of the genus: *Phycis advenella* Zincken, 1818.

The type of *Rhodophaea* is quite distinct from known American congeners. The apical process of the gnathos is divided, whereas it is undivided in New World species. The valvae of male *R. advenella* each display one long inwardly directed bar-like projection on their inner face (Figure 16). The corpus bursae of female *R. advenella* lacks pronounced signa, but is covered with minute microspicules (Fig. 20). The ductus bursa is very short when compared to those of New World species. Furthermore, the male of *R. advenella* possesses a mid-ventral hair-tuft on the eighth abdominal segment which is lacking in American *Rhodophaea.*

Rhodophaea caliginella (Hulst)

Fig. 2

Synonymy is given by Heinrich (1956) and Opler (1974). Lectotype designation is given by Opler (1974).

Diagnosis. A large gray moth usually separable from other *Rhodophaea* by the dull black inner basal patch.

Male. Length of forewing 9.5–11 mm (reared). *Inner basal* patch dull black; *basal area* of gray white-tipped scales; *basal bar* a small medial black patch edged outwardly with tan; *s-m patch* a narrow black triangle; *p-m patch* narrow, pale, composed of scales with basal half gray, distal half white; *spots* both distinct, lower the largest; *band* distinct, of black or dark gray white-tipped scales; *p-m line* distinct throughout its length, of dark gray white-tipped scales; *marginal patches* a broken line of five black elongate lines, each composed of shining black narrowly white-tipped scales.

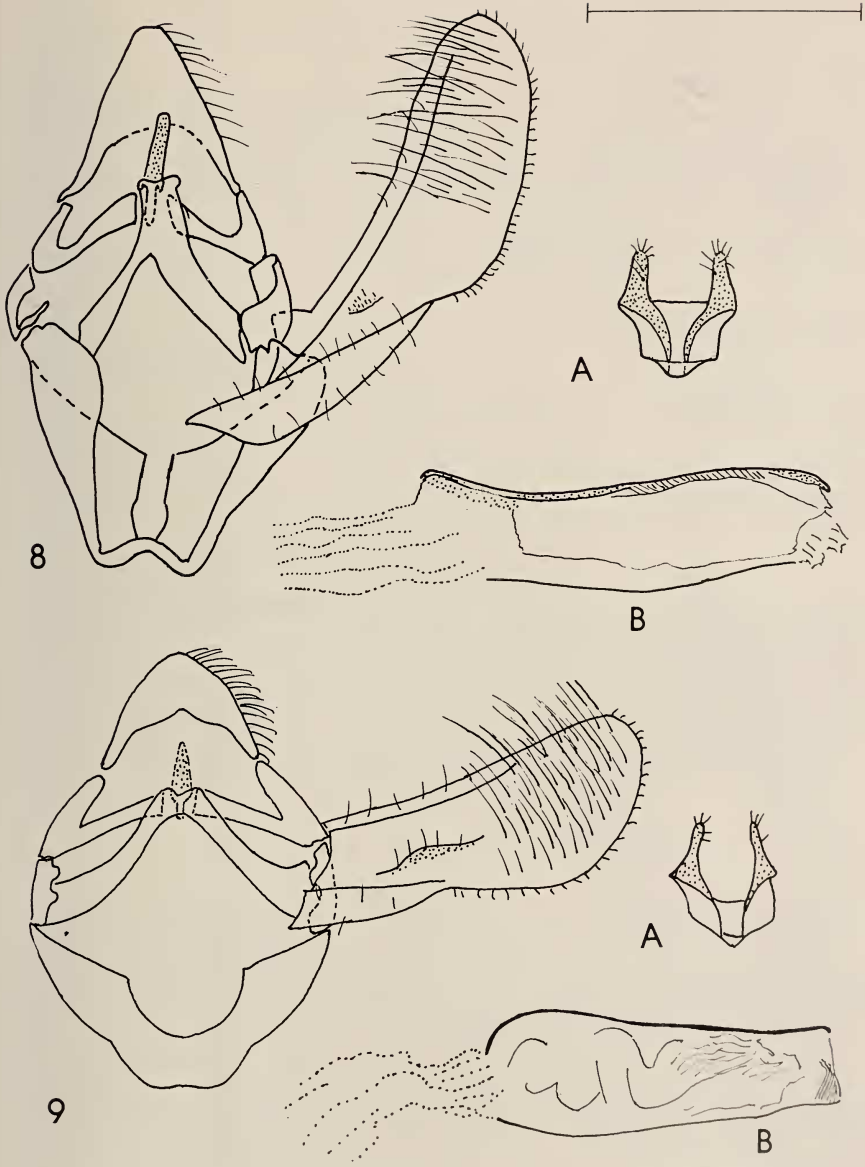
Genitalia. As in Fig. 8, valva with a small indistinct raised area on medial portion of inner face.

Female. Forewing 9–11 mm (reared). As in male except *inner basal patch* not as distinct; *basal bar* with tan scales not as extensive; *spots* upper absent; *band* merging along inner margin with *s-m patch.*

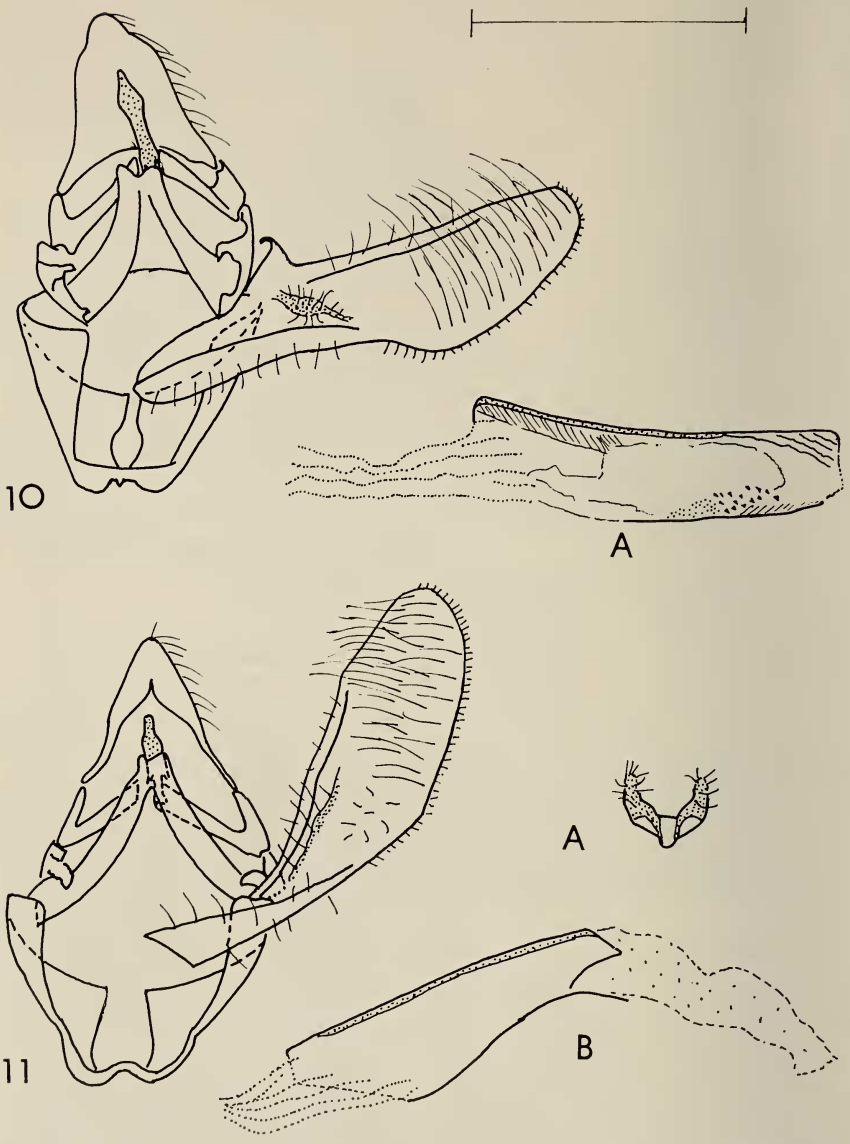
Genitalia. As in Fig. 21, corpus bursa with a small, indented, circular, scobinate patch; distinct signa lacking. Distal two-thirds of corpus bursae with pebbly texture and some minute spine-like projections.

Hosts. *Quercus agrifolia* Nee, *Q. wislizenii* A. DC. and *Q. wislizenii frutescens* Engelm.

Distribution. Known to occur only in California, but is probably also present in Baja California Norte. Distribution is coincident with that of its hosts, from Shasta County south to San Diego County in the coast range, Sierra Nevada foothills (where it is sparsely distributed), the transverse ranges, and the peninsular ranges. The moth is apparently absent from Santa Cruz Island, Santa Barbara County, where suitable hosts occur (Opler, 1970). *Quercus agrifolia* populations on the more remote Santa Rosa Island have not been sampled.



Figs. 8–9. *Rhodophaea*, male genitalia, left valva not shown, aedeagus and juxta removed, A. juxta, B. aedeagus, 8. *R. caliginella*, 9. *R. cruza*. Scale bar = 1 mm.



Figs. 10–11. *Rhodophaea*, male genitalia, left valva not shown, aedeagus and juxta removed, A. juxta, B. aedeagus, 10. *R. kofa*, 11. *R. durata*. Scale bar = 1 mm.

The Arizona specimen referred to this species by Heinrich (1956) may have been mislabelled. The specimen is *R. caliginella*, but neither host of the moth occurs in Arizona, and furthermore, the only documented Arizonan *Rhodophaea* is *R. kofa*, described below from Yuma County's Kofa Mountains, an area remote from the

State's principal oak-dominated habitats. Sampling of most Arizona *Quercus* in 1969 indicated an absence of *Rhodophaea* throughout most of that state.

Rhodophaea cruza Opler, **new species**

Fig. 3

Diagnosis. This is the only *Rhodophaea* with a purple-red inner basal patch and purple red scaling distal to the basal bar.

Male. Length of forewing 10–10.5 mm (reared). *Forewing pattern* as for *R. caliginella* male except inner *basal patch* of purplish red scales; *basal bar* a broad purplish red band for posterior two-thirds edged inwardly with a narrow black patch; *s-m patch* dark at costal margin, included scales becoming narrowly white-tipped distally and posteriorly; *p-m patch* with anterior spot absent.

Genitalia. As in Fig. 9, valvae with a low medial linear ridge on inner face extending from near base distally to half distance to tip. Juxta with small lateral projections.

Female. Length of forewing 9.5 (reared). *Maculation* as in male except *s-m patch* and *band* more extensive; both *p-m patch* spots absent; *p-m line* with adjacent reddish scales.

Genitalia. As in Fig. 23. Corpus bursa with single triangular signum composed of pointed projections, and a circular scobinate patch.

Type material. Holotype: male, California, Canada de la Cuesta, Santa Cruz Island, Santa Barbara County, 15 March 1969, reared from *Quercus dumosa*, J. Powell lot 69C40, emerged 30 June 1969, P. Opler prep. 78, P. A. Opler collector. Allotype: female, same data except P. Opler prep. 81. Paratypes: 3 ♂♂, 4 ♀♀ same data except some emerged 29 June and 4 July.

Host. *Quercus dumosa* Nutt.

Distribution. Santa Cruz Island, Santa Barbara County, California.

Discussion. Present evidence indicates this moth is endemic to Santa Cruz Island, yet future study may well alter this assignment. On Santa Catalina Island, Los Angeles County, a single *Rhodophaea* shelter was found on *Quercus dumosa*, so that *R. cruza* could eventually prove to be endemic to more than one California island. On the mainland, larvae and shelters were found on *Quercus dumosa* throughout much of its range, but only one reared individual exists (a male from Los Angeles County). Color pattern and genitalic features relate this individual to *R. cruza*, but it differs to such a degree that assignment to that species is unsure.

Rhodophaea kofa Opler, **new species**

Fig. 4

Diagnosis. The extensiveness of white-tipped scales gives this moth a distinctive "salt and pepper" appearance.

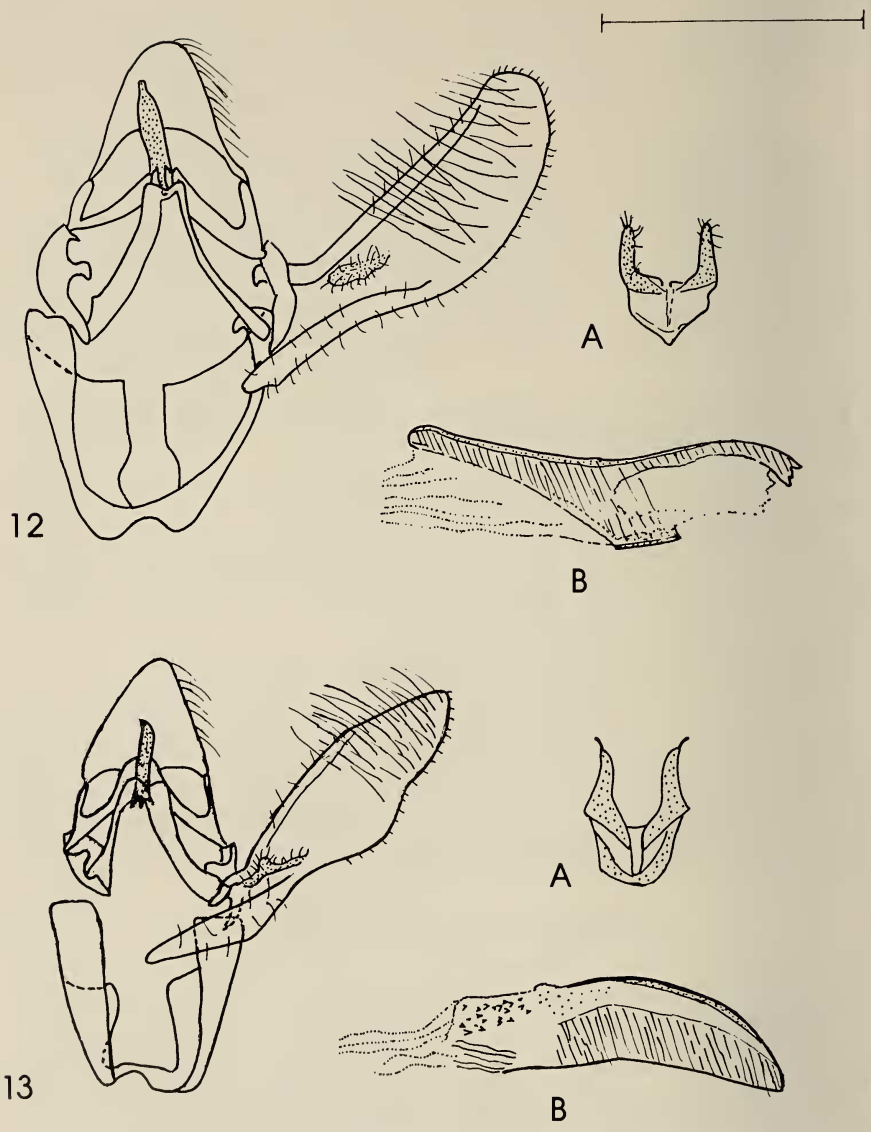
Male. Length of forewing 7–8.5 mm (reared). Forewing as for *R. caliginella* male except *inner basal patch* of white-tipped black scales; *basal bar* mostly tan, inwardly edged with narrowly white-tipped black scales; *s-m patch* very restricted in size; *p-m patch* very extensive along costal margin; *spots* both present with narrowly white-tipped black scales; *band* restricted, not extending to inner margin.

Genitalia. As in Fig. 10. Valva with a stout diagonal ridged swelling at base of inner face.

Female. Length of forewing 8.5 mm (reared). Forewing as in male except marginal patches extending to costal margin.

Genitalia. As in Fig. 18. Similar to that of *R. cruza*, corpus bursa with singular triangular signum of pointed projections, and with a circular scobinate patch, denser and more extensive than that of *R. cruza*.

Type material. Holotype: male, Arizona, Palm Canyon, Kofa Mountains, Yuma



Figs. 12–13. *Rhodophaea*, male genitalia, left valva not shown, aedeagus and juxta removed, A. juxta, B. aedeagus, 12. *R. fria*, 13. *R. neva*. Scale bar = 1 mm.

County, 8 April 1963, reared from *Quercus turbinella* × *ajoensis* hybrid, J. Powell lot 63D11, emerged 12 May 1963, P. Opler prep. 42, C. A. Tauber (Toschi) and J. Powell collectors. Allotype: female, same data except emerged 10 May 1963, P. A. Opler prep. 82. Paratypes: 3 ♂♂, 8 ♀♀ same data except some emerged various dates between 19 April and 31 May 1963.

Host. *Quercus turbinella* × *ajoensis.*
Distribution. *R. kofa* is known only in the Kofa Mountains, Yuma County, Arizona.

Rhodophaea durata Opler, new species

Fig. 5

Diagnosis. This moth is extremely similar to *R. caliginella* but is separable by the combination of a pale brown or dark gray inner basal patch and the brown scales on the distal portion of the basal bar.

Male. Length of forewing 7.5–9.5 mm (reared). Forewing as for *R. caliginella* male except *inner basal patch* of pale brown scales; *basal bar* of pale brown scales not reaching either costal or inner margins, inwardly edged with narrow black band; *s-m patch* of all black scales, limited in extent; *seven* small *marginal patches.*

Genitalia. As in Fig. 11. Similar to that of *R. cruza.* Juxta lacking lateral projections.

Female. Length of forewing 9 mm (reared). Forewing as for male except *inner basal patch* dark gray with a few reddish brown scales intermixed; *basal bar* with reddish brown instead of pale brown scales; *s-m patch* with dark more extensive, merging broadly with *band*; *p-m patch* distinct but reduced in extent.

Type material. Holotype: male, California, Alpine Lake, 1100′, Marin County, 25 April 1958, reared from *Quercus durata*, J. Powell lot 58D10, emerged 14 June 1958, P. Opler prep. 75, J. A. Powell collector. Allotype: female, same locality as holotype, 15 April 1972, reared from *Quercus durata*, J. Powell lot 72D10, emerged 27 June 1972, abdomen lost, J. Powell collector. Paratypes: 9 ♂♂, 1 ♀ same locality date, 3 ♂♂ from 1958 collection, 5 ♂♂, 1 ♀ (abdomen lost) from 1972 collection, 1 ♂ 17 April 1970 reared from *Quercus durata*, J. Powell lot 70D48, emerged 3 June 1970, J. A. Powell collector.

Host. *Quercus durata* Jeps.

Distribution. This moth is known only in the slopes of Mt. Tamalpais, Marin County. The range of the moth is presumed to be more extensive, since larval shelters were found on *Q. durata* at Cedar Mountain, Alameda County, and nine miles west of Atascadero, San Luis Obispo County. At other localities where the host was searched no *Rhodophaea* shelters were found, and *R. durata* has an even patchier distribution than its host.

Rhodophaea fria Opler, new species

Fig. 6

Diagnosis. This moth is distinguished by its gray inner basal patch and the fact that the *p-m line* is indistinct near the inner margin.

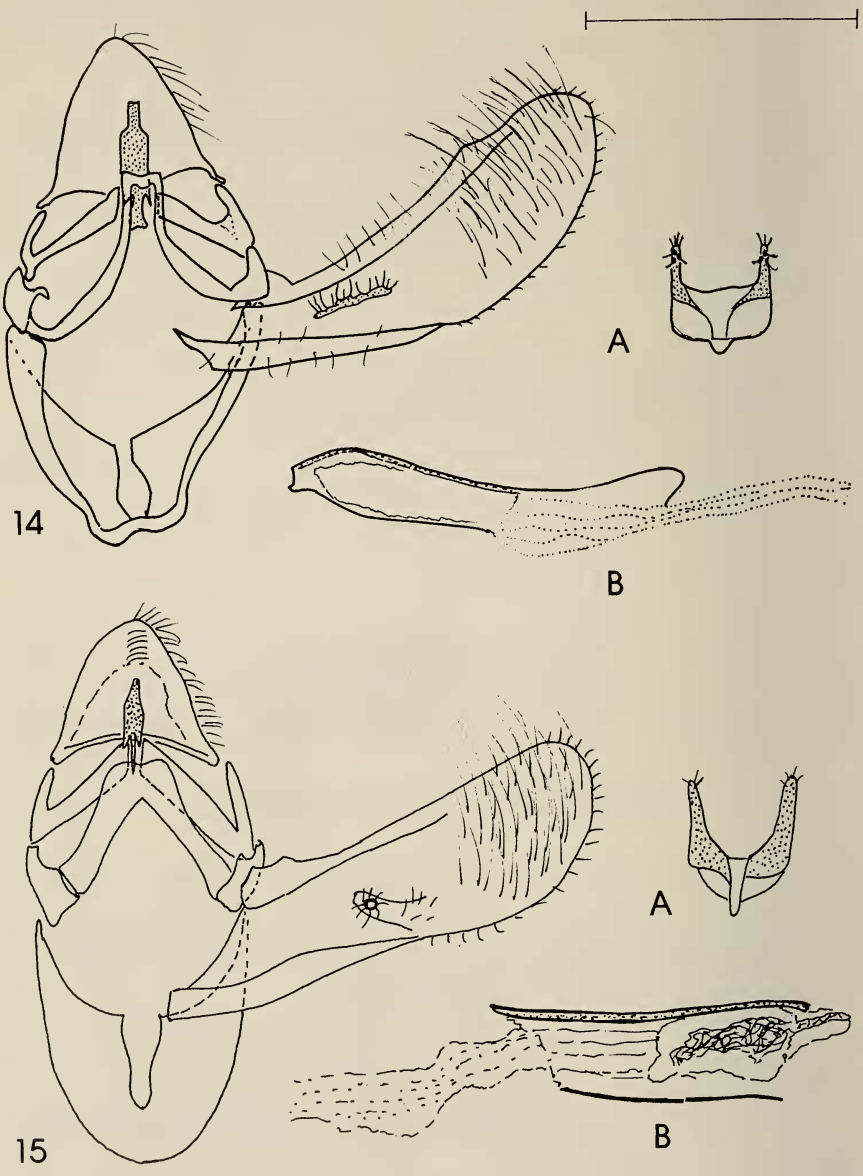
Male. Length of forewing 9.5–10 mm (reared). Forewing as for *R. caliginella* male except *inner basal patch* gray; *basal bar* with outer portion brown; *s-m patch* small, restricted; *band* present, dark on costal margin, paler toward inner margin; *p-m line* indistinct near inner margin, very narrow.

Genitalia. As in Fig. 12. Valva with a bulbous, irregular projection on medial portion of inner face. Juxta with darkened sclerotized areas not extending to base.

Female. Length of forewing 9.5 mm (reared). Forewing as for male except *s-m patch* more extensive.

Genitalia. As in Fig. 17. Corpus bursa with two signa consisting of approximately rectangular patches of pointed projections arranged in rows, and with a small quadrangular patch of scobinations.

Type material. Holotype: male, California, 4 mi. SE Clayton Contra Costa County, 26 May 1968, reared from *Quercus douglasii*, J. Powell lot 68E64, emerged 27 June 1968, P. Opler prep. 35, P. A. Opler collector. Allotype: female, same data except emerged 10 July 1968. Paratypes: 5 ♂♂, 5 ♀♀, same data as holotype, emerged 14 June–5 July 1968; 3 ♀♀, Russelmann Park, Contra Costa County,



Figs. 14–15. *Rhodophaea*, male genitalia, left valva not shown, aedeagus and juxta removed, A. juxta, B. aedeagus, 14. *R. yuba*, 15. *R. suavella*. Scale bar = 1 mm.

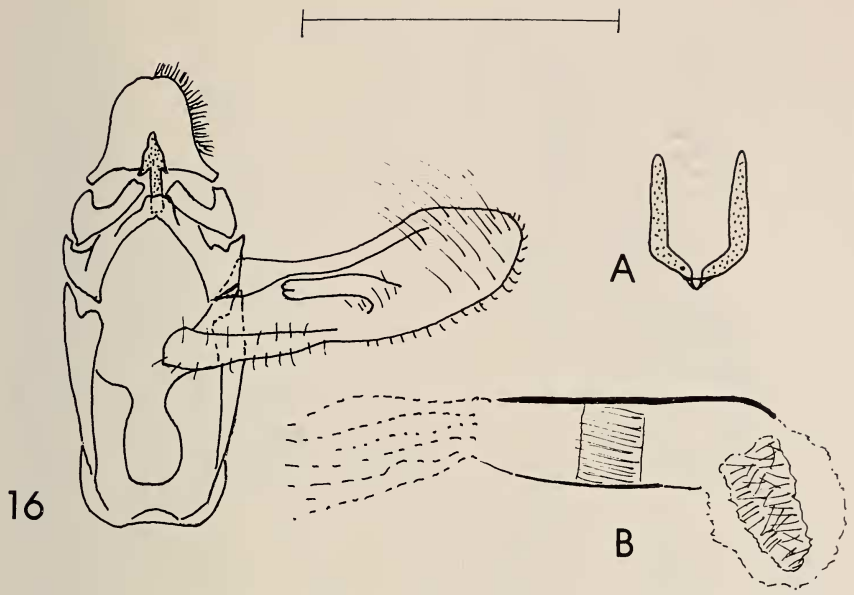


Fig. 16. *Rhodophaea advenella,* male genitalia, left valva removed, A. juxta, B. aedeagus. Scale bar = 1 mm.

California, 11 May 1968, reared from *Quercus douglasii,* J. Powell lot 68E23, emerged 10–14 June 1968; 1 ♂ 8 miles southeast Clayton, Contra Costa County, California, 26 May 1968, reared from *Quercus douglasii,* J. Powell lot 68E53, emerged 27 June 1968, P. A. Opler collector.

Host. *Quercus douglasii* H. T.

Distribution. In addition to adults reared from *Q. douglasii* at localities on the eastern slope of Mt. Diablo, Contra Costa County, shelters were found on this host at Folsom Dam (Sacramento County), 6 mi. SW Mariposa, Mariposa County, and at Keene and 6 mi. S Monolith, both Kern County.

Discussion. This species is the only defined Nearctic *Rhodophaea* which feeds on a deciduous host. The leaves which surround its silken larval shelters are tied to host twigs prior to leaf abscission in fall. The partially grown larvae thus overwinter *in situ* and complete their development on newly produced leaves in the spring.

Rhodophaea neva Opler, **new species**

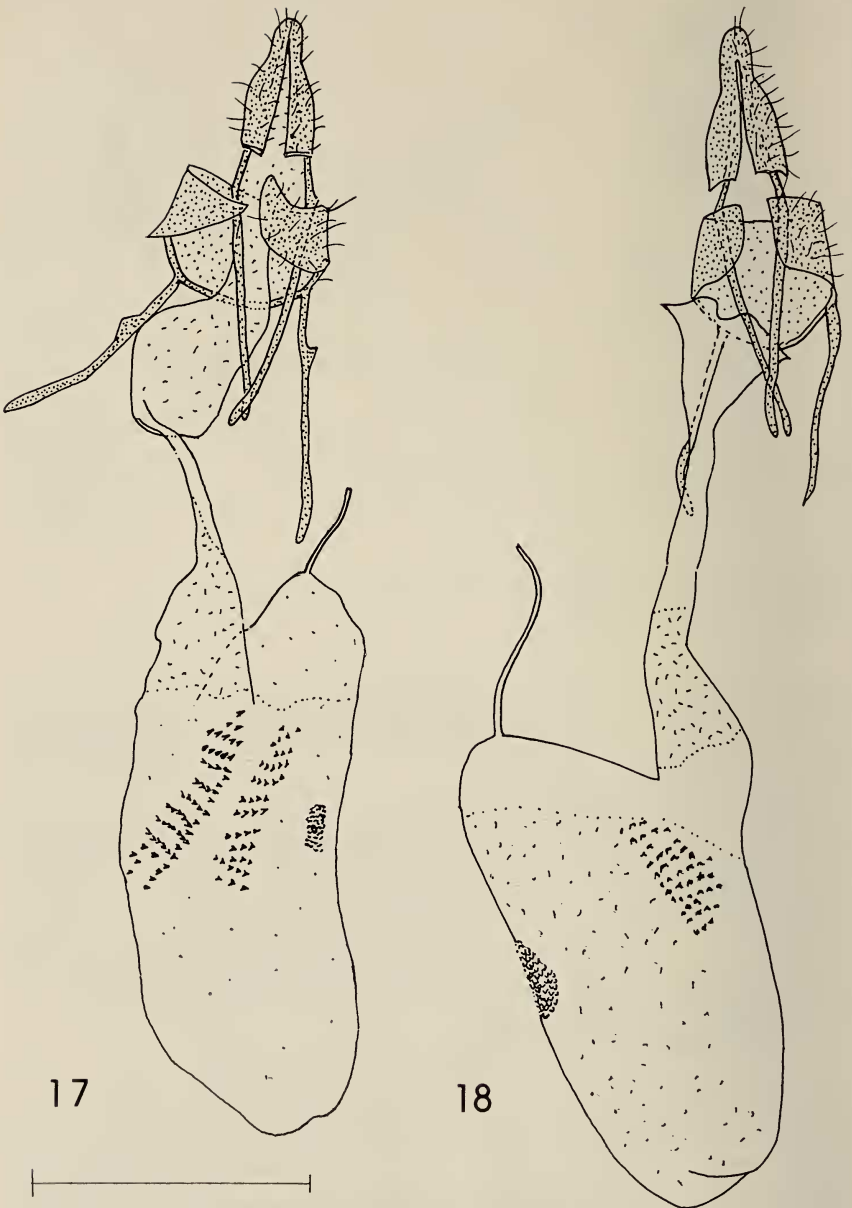
Fig. 7

Diagnosis. This moth is separable by the combination of a dark basal area, broad basal bar, and vague indistinct patches.

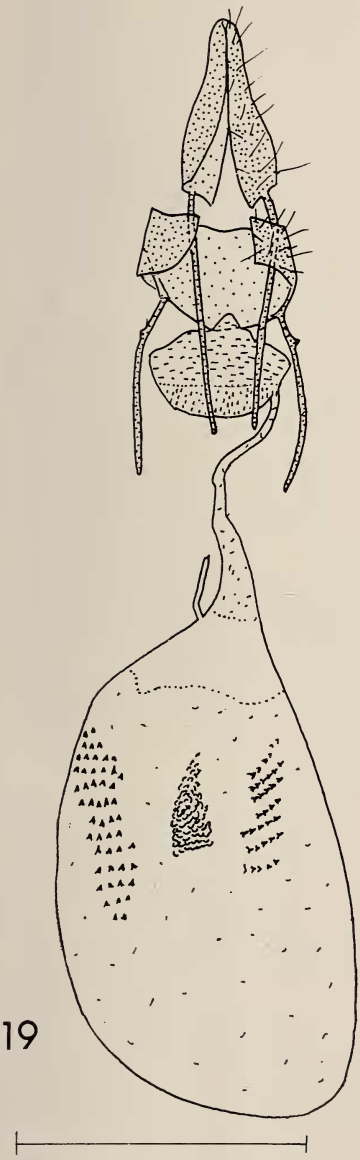
Male. Length of forewing 8.5–9 mm (reared). Forewing scaling of allotype male rubbed presumed to be as in female.

Genitalia. As in Fig. 13. Valva with a ridged projection on basal portion of inner face surmounted by a tubercular process.

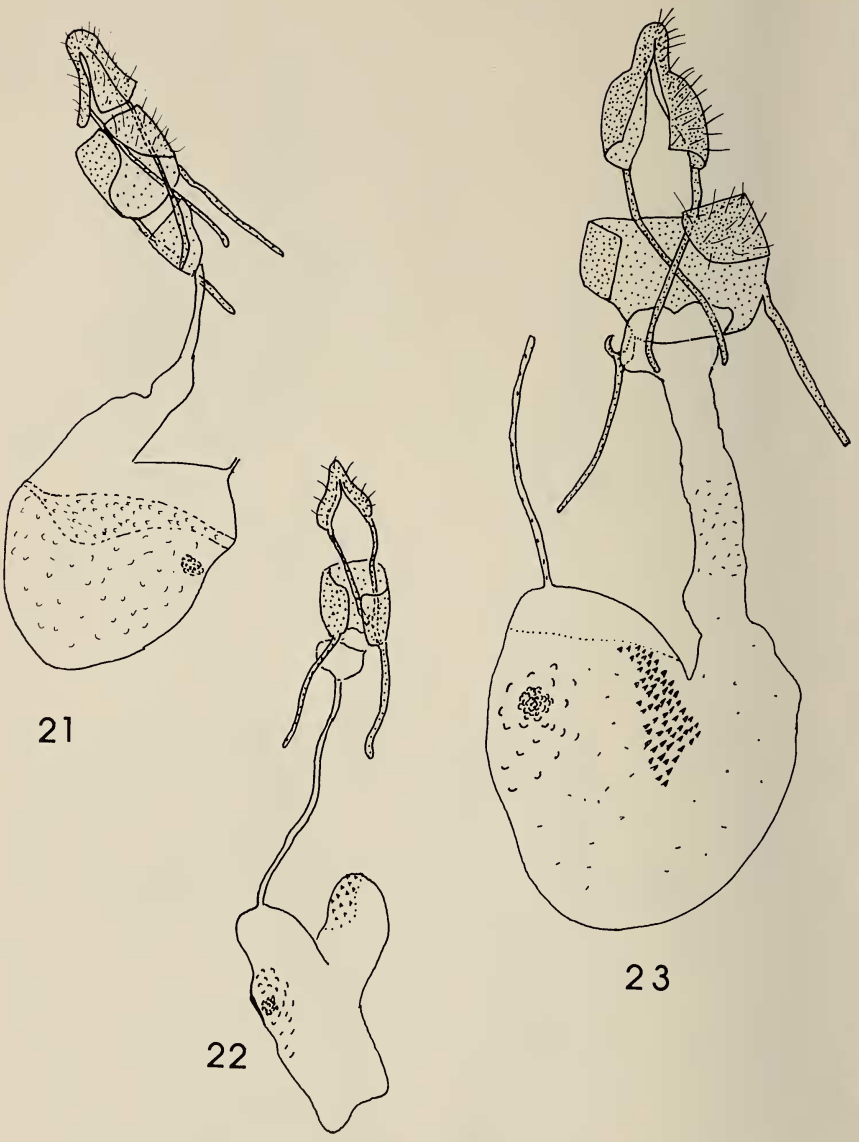
Female. Length of forewing 8.5 mm (reared). Forewing as for *R. caliginella* males except *inner basal patch* of reddish brown scales; *basal area* dark, pale only



Figs. 17–18. *Rhodophaea*, female genitalia, 17. *R. fria*, 18. *R. kofa*. Scale bar = 1 mm.



Figs. 19–20. *Rhodophaea*, female genitalia, 19. *R. neva*, 20. *R. advenella*. Scale bar = 1 mm.



Figs. 21–23. *Rhodophaea*, female genitalia, 21. *R. caliginella*, 22. *R. suavella*, 23. *R. cruza*.

adjacent to *basal bar*; *basal bar* broad, of reddish brown scales, inner black portion for posterior ⅔; *band* especially black at costal margin becoming diffuse inwardly; scattered pale brown scales along inner margin. *Marginal patches* vague, not distinct.

Genitalia. As in Fig. 19. Corpus bursa with two signa similar in configuration to

those of *R. fria*, but with one distinctly larger. The scobinate patch is between the signa, rather than to one side as in *R. fria*, and is triangular in outline.

Type material. Holotype: female, Nevada, summit Kingsbury Grade, Douglas County, 30 June 1968, reared from *Chrysolepis sempervirens*, J. Powell lot 68F108, emerged 9 July 1968, P. A. Opler collector. Allotype: male, same data except 17 May 1969, J. Powell lot 69E88, emerged 29 June 1969. Paratypes: 2 ♀♀, same data as holotype, emerged 6 and 9 July 1968.

Host. *Chrysolepis sempervirens* (Kell.) Hjelm.

Distribution. This moth is known only from the type locality, but it probably occurs at other localities where its host occurs in the Carson Range. No evidence of this species' presence was found at other localities where the host was sampled. Sampling of *Chrysolepis chrysophylla* (Doug. ex. Hook.) Hjelm. failed to disclose evidence of *Rhodophaea*.

Rhodophaea yuba Opler, new species

Diagnosis. This moth has a more uniform pale gray appearance than its congeners, and is further distinguished by its indistinct band and pale gray tan scales on the distal margin of the basal bar.

Male. Length of forewing 10.5 mm (reared). Forewing as for *R. caliginella* male except *inner basal patch* of pale tan scales; *basal bar* indistinct, pale gray tan, narrowly edged inwardly with black; *s-m patch* restricted; *p-m patch* with dull white scales; *band* present but indistinct; *p-m line* distinct but narrow, becoming indistinct toward costal margin; *marginal patches* a distinct narrow broken line, becoming indistinct at inner margin.

Genitalia. As in Fig. 14. Valva with a low irregular ridge-like protuberance on medial portion of inner face. Juxta truncate ventrally.

Type material. Holotype: male, California, Yuba Pass summit, 6708 feet elevation, Sierra County 19 April 1968, reared from *Quercus vaccinifolia*, J. Powell lot 68D152, emerged 10 June 1968, P. A. Opler collector.

Host. *Quercus vaccinifolia* Kell.

Distribution. This moth is known only from the type locality. *R. yuba* may range widely through the range of its host, which was sampled at few localities.

Rhodophaea suavella (Zincken)

Phycis suavella Zincken, 1818.
Myelois suavella: Herrich-Schaffer, 1849.
Eurhodope suavella: Meyrick, 1927.
Rhodophaea suavella: Ragonot, 1893.
Rhodophaea supposita Heinrich, 1956 (New Synonymy).

Diagnosis. This moth is distinguished from other *Rhodophaea* by its dark appearance, absence of an *s-m patch*, and more distal placement of the basal bar which lacks black scaling.

Male. Length of forewing 9–10 mm (reared). Maculation as in *R. caliginella* except *inner basal patch* brown; *basal area* dark, not clearly differentiated; *basal band* positioned more distally on wing, narrow white, not edged inwardly with black; *s-m patch* absent; *p-m patch* strongly reduced; *band* present but indistinct on posterior half of wing.

Genitalia. As in Fig. 15. Valva with long projection on inner face surmounted by a more heavily sclerotized circular setiferous area.

Female. Length of forewing 8.5 mm (reared). Forewing as for male.

Genitalia. As in Fig. 22. Corpus bursa lacking distinct signa, but with an indented scobinate patch on medial portion, and a small area of minute thorn-like projections on proximal portion.

Hosts. Various Rosaceae: *Cotoneaster* (British Columbia), *Crataegus* spp. (England), *Prunus* (France).

Distribution. In North America known only from Vancouver, British Columbia, Canada. In the Palaearctic in southern England, central and southern Europe, as well as the Near East.

Future Taxonomic Work

During the 1967–1970 study of California Oak Microlepidoptera, *Rhodophaea* larvae and shelters were discovered on five hosts from which no reared material is currently available (Opler, 1970). These were *Lithocarpus densiflora*, *Quercus chrysolepis*, *Q. dunnii*, *Q. engelmanni* and *Q. garryana*. Moths feeding on *Lithocarpus* can be expected to represent an undescribed species, while at least one and possibly other undescribed species are represented by moths which feed on the other four. The specific identity of *Rhodophaea* associated with *Quercus dumosa* throughout its range must be studied in detail.

Acknowledgments

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